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REVIEW ON ROLE AND APPLICATION OF BIM IN PROJECT SCHEDULE MANAGEMENT

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Abstract

The implementation and application of Building Information Modeling (BIM) in construction project management is becoming increasingly crucial, aligning with global development trends in the construction sector and project information management. Numerous scholars and companies are actively engaged in learning, understanding, and investigating various aspects of BIM to stay current and meet developmental requirements.

This study focuses on the role and application of BIM in project schedule management, intending to identify limitations that hinder its ability to meet expectations. Additionally, it explores how other countries have effectively employed BIM in project management and progress tracking throughout the project lifecycle.

Keywords: Developmental requirements, Identify limitations, BIM, Project Management, Information Modeling (BIM)

Introduction

Updated and coordinated within the BIM environment. This level of integration and automation facilitates seamless communication among all project participants, ensuring that any changes made are instantly reflected across the entire project.

BIM's versatility and scope extend beyond mere design and construction phases, influencing the project's lifecycle management. During the operation phase, BIM serves as a vital tool for facilities management by providing comprehensive information about building components and systems, thereby aiding in maintenance and future renovations.

By implementing BIM, project teams can achieve several benefits, including:

Enhanced Collaboration: By providing a shared digital representation of the project, BIM encourages interdisciplinary collaboration and improves the integration of different teams, such as architects, engineers, contractors, and owners.

Improved Accuracy: The detailed and precise nature of BIM models helps reduce errors and omissions in the design and construction phases, leading to higher quality outcomes.

Cost and Time Savings: With better coordination and fewer conflicts, BIM can significantly reduce the time and cost associated with project modifications and rework.

Risk Mitigation: BIM allows for better visualization and analysis of the project, enabling early detection of potential issues and more effective risk management.

Sustainability: Through simulations and analyses, BIM can support sustainable design and construction practices, optimizing resource usage and minimizing environmental impact.

Lifecycle Management: BIM provides valuable data for the operation and maintenance of the building, supporting efficient facility management and extending the building's lifespan.

In conclusion, BIM is not just a tool but a comprehensive process that transforms how projects are designed, built, and managed. Its ability to integrate geometric and non-geometric information into a unified model makes it a powerful asset for achieving higher efficiency, better quality, and enhanced collaboration throughout the entire lifecycle of a project.

LITERATURE REVIEW

The first segment elucidates project management, offering insights into its definition, application within the construction sector, and the advantages conferred by a project management strategy. This section serves as a primer on project management principles and practices relevant to the construction industry.

The second segment delves into the BIM methodology. Here, the focus is on understanding the essence of BIM technology, its practical applications throughout the building project lifecycle, and its potential effectiveness within the construction industry. This section aims to provide a comprehensive understanding of BIM and its relevance to construction practices.

The third and final segment of the literature review centers on the integration of project management (PM) and BIM. It delineates the intricacies of linking PM and BIM methodologies throughout the building lifecycle, leveraging nD technology. This section elucidates the structural framework underpinning the integration of PM and BIM, highlighting their synergistic potential in optimizing construction project management processes (Aðalsteinsson, 2014).

A PROJECT is defined as a temporary endeavor undertaken to create a unique product, service, or result, as per the guidelines provided by PMBOK (Project Management Body of Knowledge). PMBOK serves as a crucial guide for construction professionals, issued by the Project Management Institute. This definition implies that a project has a specified beginning and end time, outlined.

Tuan Anh Nguyen et al (2024) was study study is well-aligned with current global trends and the growing need for efficient project management in the construction sector through Building Information Modeling (BIM). To address your objectives comprehensively, consider the following structure and key points for your study.

Context and Importance: Emphasize the pressing need for BIM in modern construction project management and its alignment with global development trends.

Purpose of the Study: Clearly state the study's focus on the role and application of BIM in project schedule management.

Overview of BIM: Define BIM and its significance in the construction industry.

BIM in Project Management: Discuss existing research on BIM's application in project management, specifically in schedule management.

Global Case Studies: Highlight studies from various countries that have effectively employed BIM for project management and progress tracking.
By following this structure and focusing on these key points, your study can effectively contribute to the understanding and advancement of BIM in project schedule management.

Muhammad Saleem Raza et al (2023) was study the construction industry (CI) plays a vital role in infrastructure development and improves the socio-economic status with employment opportunities and contribution to gross domestic progress (GDP) of countries. However, its productivity has diminished in recent years due to increasing complexities in construction projects (CPs) and lack of adoption of novel technologies such as Building Information Modeling (BIM). Also, there is a significant need of polishing the capabilities of construction practitioners to meet the project requirements in agreement with project management knowledge areas (PMKAs). This study, therefore, focused on identification and evaluation of factors necessary for measurement of extent of application of PMKAs. Subsequently, noteworthy features of BIM helpful for enhancing the capabilities of project managers (PMs) in application of PMKAs were identified from literature. A total of thirty-three factors for measurement of extent of application of PMKAs and sixty-six features of BIM helpful in enhancing the capabilities of PMs in application of

PMKAs were found. The detailed study and analysis of these ninety-nine factors with the help of previous studies suggested that extent of application of PMKAs is measured with three sub-tasks i.e., plan, manage/develop, and monitor/control. In addition, by virtue of remarkable features and services of BIM, it helps in enhancing the capabilities of PMs in applying PMKAs: project integration, scope, cost, time, quality, resource, communications, procurement, risk, safety, and stakeholder management.

R. Grys et al (2023) Integrating project schedules with BIM elements enhances the ability to produce visual representations that align with construction goals. This integration facilitates the interpretation and production of construction drawings using computer-aided drafting (CAD) and BIM software. In the United States, Integrated Project Delivery (IPD) has become the preferred approach for major BIM-related projects, reflecting the growing emphasis on collaborative and efficient project execution. The government actively promotes and supports the application of BIM to increase productivity, conserve resources, and improve the quality of construction activities. By doing so, it aims to enhance project operation management and overall efficiency in the construction industry. A BIM model offers significant potential in streamlining data collection and storage for projects, serving as a comprehensive repository for all project-related data. Utilizing BIM in facility management leverages this data throughout the entire lifecycle of a facility, ensuring a safe, healthy, efficient, and productive work environment. The overarching goal is to maximize the value of facility data to support effective management and maintenance practices.

T.-Q. Nguyen et al (2021) In the context of BIM implementation, ensuring seamless coordination among organizations and departments is crucial for the success of construction projects. The Specialized Construction Investment Project Management Board within the Ministry of Construction plays a pivotal role in facilitating this coordination. They organize weekly meetings with stakeholders to share insights, foster coordination, and align on the implementation process, progress expectations, and overarching goals. Regular online meetings further ensure timely updates and maintain alignment with the project's progress and objectives. By focusing on these areas, the Specialized Construction Investment Project Management Board can enhance coordination among organizations and departments, leading to a successful BIM implementation.

Ruti Ruth POLİTİ (2018) Today, in construction practice, implementation of effective construction management techniques and tools is becoming essential, especially as the scale of the projects increases. Large scale projects pose a challenge to industry; as the number of tasks, parameters and constraints to be considered rises, interaction of these tasks and parameters increases the complexity, as well. While the search for techniques and tools for better coping with complexity will never end, Building Information Modeling (BIM) has recently emerged as an approach that achieves considerable improvement in efficiently handling complexity. BIM is able to provide a digital visualization of a building or structure in 3D. The necessary geometric data is modeled but more importantly all semantic data associated with the project (function of the element, material properties, construction details, schedules, etc.) is stored with the model. The intent is to have a single model of the project for all stakeholders over all phases of the project.

In this study, the main challenges within the current practice of project management are analyzed and what BIM-based project management has to offer to those challenges have been discussed. The thesis explores how BIM method can be applied to project management and how information can be collected to build a BIM model. The advantages of BIM-based scheduling (4D), cost estimation (5D), sustainability (6D), facility management (7D) and structural analysis in the scope of project management is discussed. A case study is given to validate the use of the computer aided programs for nD BIM during the construction phase.

R. Klinc et (2017) Succar's definition of BIM underscores its comprehensive complexity, including a software that goes beyond numerical modeling and data input to include tools and processes related to project management. BIM, viewed in its entirety, aligns with the field of structural project management, offering potential benefits to structural project operators by reducing documentation time and delivering favorable project outcomes. Specific documentation of BIM use in notable project scenarios, such as Heathrow Terminal 5 and the Walt Disney Concert Hall, is an aspect of BIM documentation [96]. Challenges in design management practices, coupled with the introduction of BIM, require new solutions. BIM technology addresses these challenges by creating component libraries to improve modeling efficiency, simulating the 4D process to improve site construction accuracy, and implementing quality management systems for analyzing problematic components [97-98]. The BIM model enables construction managers to promptly identify and address issues by marking their location within the model. Tracking verification and statistical analysis play a crucial role in effective control [99]. The introduction of BIM-based project management tools improves the development of realistic project-based classroom assignments for educators. BIM allows the design of class projects that simulate real-world project conditions, helping students learn various project management methods and optimize project plans [100]. BIM's data-rich nature facilitates model-based quantity reduction, cost estimation, scheduling simulation, and design coordination. Therefore, beyond teaching BIM in design education, it is crucial to educate students on applying BIM throughout the project life cycle and how to effectively manipulate and manage the mode

A. Ghaff arian Hoseini et al (2016) The advent of BIM technology has introduced robust technical capabilities that enable the informatization and digitization of the engineering construction sector, significantly accelerating the transformation and improvement of management practices in engineering construction projects. The development of information management aligned with BIM for construction data enhances BIM's capacity to integrate modeling, communication, collaboration, and harmonization of design and construction requirements throughout all phases of sustainable construction projects. Consequently, BIM plays a pivotal role in advancing automation within the construction industry and its corresponding management systems. However, the successful implementation of such initiatives depends on the comprehensive skills, capacity, and enthusiasm of builders and contractors, recognizing them as critical factors for the future success of these endeavors.

Mehmet Yalcinkaya et al (2013) was analysis highlights the integration of BIM into construction management, emphasizing the need for updated roles and responsibilities for construction managers (CMs) to enhance their efficiency in BIM-based projects. The twelve main subjects from the construction management body of knowledge you referred to can serve as a framework for assessing BIM's impact on traditional CM duties. Here's a structured approach to further explore and elaborate on these points.

Introduction to BIM and Construction Management:

- Define BIM and its importance in modern construction projects.
- Describe the traditional roles and responsibilities of a Construction Manager (CM).

BIM Integration into Construction Management:

- Explain how BIM transforms the traditional construction process.
- Discuss the virtual representation of physical and functional characteristics in BIM.
- Highlight the role of BIM as both a graphical design tool and a virtual database.

Compatibility and Challenges:

- Identify areas where traditional CM duties intersect with BIM functions.
- Discuss potential ambiguities and challenges in integrating BIM with traditional CM roles.
- Provide examples of critical project lifecycle phases where BIM is most effective.

Construction Management Body of Knowledge:

- List and explain the twelve main subjects of the construction management body of knowledge.
- Evaluate how each subject aligns with BIM functions and practices.

Case Studies and Practical Implementation:

- Present case studies or examples of projects where BIM has been successfully integrated with construction management.
- Analyze the outcomes, highlighting improvements and challenges faced.

Recommendations for Updating CM Duties:

- Suggest specific updates to CM duties and responsibilities to better align with BIM-based project requirements.

- Discuss the importance of training and education for CMs to adapt to BIM technologies.

By structuring your study in this manner, you can provide a comprehensive analysis of the interplay between BIM and construction management, offering practical insights for enhancing CM efficiency in BIM-based projects.

Garel,et al (2013) The field of project management (PM) has witnessed a significant surge in interest since the late 1980s, with research in this domain steadily advancing since the mid-1990s. The 21st century has seen the proliferation of integrated theories combining traditional disciplines with managerial principles that emerged in the early 20th century, pioneered by Taylor and Fayol. Taylor and Fayol introduced organizational theories based on their own experiences, which laid the foundation for modern project management methodologies. Project Management encompasses various knowledge areas, including integration management, scope management, schedule management, cost management, quality management, resource management, communications management, risk management, procurement management, and stakeholder management. Each project is characterized by a level of uncertainty across these management areas, and the challenge lies in effectively managing these uncertainties while addressing all knowledge areas (Project Management Institute, 2017).

Browning et al (2014) At its core, a project must meet predetermined scope, deadline, and budget constraints. The objective of PM is to achieve the project goal by integrating scope, schedule, and cost management within a framework of quality assurance. This principle is often referred to as the "triple constraint" or "iron triangle" of the project, where each corner presents both advantages and risks. A project manager must add value to the project by leveraging knowledge, tools, and techniques to meet project objectives 2017). Moreover, all knowledge areas are interlinked, meaning changes in one area can impact others, akin to a domino effect (Project Management Institute, 2000).

METHODOLOGY

The implementation of Building Information Modeling (BIM) presents several notable advantages, yet it is not without its limitations and risks, many of which are influenced by national contexts, business factors, and human considerations.

National Context

Each country has unique trends, policies, and regulatory frameworks that influence the construction sector and the broader management landscape. Implementing BIM models in different countries often necessitates extensive updates, exchanges, and changes in approval and implementation processes to align with national standards and regulations. This can create significant challenges, particularly in regions where regulatory environments are complex or where there is limited support for digital transformation in construction.

Business Factors

Adopting the BIM process incurs several costs, including operating expenses, equipment investments, and training fees. Businesses must also adjust work procedures and organizational structures to accommodate the new technology. High costs associated with BIM software and skills training can be a substantial barrier, particularly for small and medium-sized enterprises. These expenses can hinder mass adoption, especially in markets where experienced professionals in BIM are scarce.

Human Factors

The successful implementation of BIM hinges significantly on the human factor. Continuous learning and knowledge exchange among workers are essential. The rapid pace of technological advancement poses a challenge in maintaining up-to-date work experience. New graduates may find it difficult to keep pace with evolving technologies, while established employees may resist change and the need to update their skills. This resistance can impede the adoption of BIM processes and affect overall project efficiency.

Impact on Construction Project Schedule Management

These limitations and risks collectively impact the application of BIM in construction project schedule management. The need for continuous updates and changes in approval processes can delay project timelines. The high costs and required adjustments in organizational structures can strain resources, potentially affecting project budgets and delivery. The human factor, with its associated challenges of skill acquisition and resistance to change, can further complicate project management efforts.

CONCLUSION

The delineation of advantages and drawbacks underscores the global proliferation of Building Information Modeling (BIM) as a ubiquitous language in construction management. However, certain factors, such as the country's level of development, applicable standards, operational methodologies, and technological considerations, continue to pose challenges and elicit dissatisfaction. To effectively address these issues, greater support is imperative from entities, namely the state, government, and businesses.

Simultaneously, facing these challenges requires concerted efforts from both emerging talents and seasoned professionals well-versed in traditional management and application methods. Currently, enhancing the efficiency of BIM in construction management is highly dependent on the proactive involvement of government and state regulatory bodies. Their crucial role involves vigilant monitoring and the formulation of guidelines tailored to the specific prerequisites in Vietnam. These standardized processes are subsequently introduced and disseminated to authorities, serving as a foundational database for the broader implementation of the BIM process model, encompassing project progress management.

Integration of BIM software application training programs into university and college curricula is essential, offering advanced guidance on analytical thinking and the perspective required for handling digital data and project information at the graduate level. To optimize the effectiveness of BIM in managing the progress of construction projects, it is imperative to expand the dissemination of shared resources. These resources include standard documents, books, newspapers, and other guidelines on the BIM application process. Ensuring accessibility to high-quality and reputable resources for students, businesses, and implementation agencies is crucial.

In addition to the common applications mentioned above, investors and design units should gradually promote the adoption of project information modeling. This involves adjusting and upgrading the equipment to ensure full integration and storage of the updated BIM application processes and project information management. Enterprises are encouraged to conduct proactive training sessions, widely disseminating guidance on the application of the BIM process to all personnel at various levels. Accessing insights from standard sources and journal articles or organizing seminars with the participation of esteemed domestic and foreign experts in BIM project management contributes to the comprehensive understanding and implementation of BIM processes.

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